Summertime Extreme Heat Events and Hospitalizations for Acute Myocardial Infarction in Maryland: 2002-2012

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Acknowledgements

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Conflict of Interest :

- None

Background

- Previous studies have shown associations between cardiovascular risk and ambient temperature
  - Many focused on CVD mortality

- Existing studies on temperature and non-fatal acute myocardial infarction (AMI)
  - Consistently higher risk from cold
  - Inconsistent on effect from heat
  - Few studies exploring population subgroups

Background

- Inconsistency may partially be explained by differing methodologies used to classify temperature
  - Linear
  - Non-linear (splines)
  - Threshold
  - Season

- Important to consider temperature norms and local adaptability

- For this study, we used **Extreme Heat Events**, built using location and calendar day specific climatology, as exposure metric

Defining Extreme Heat Events

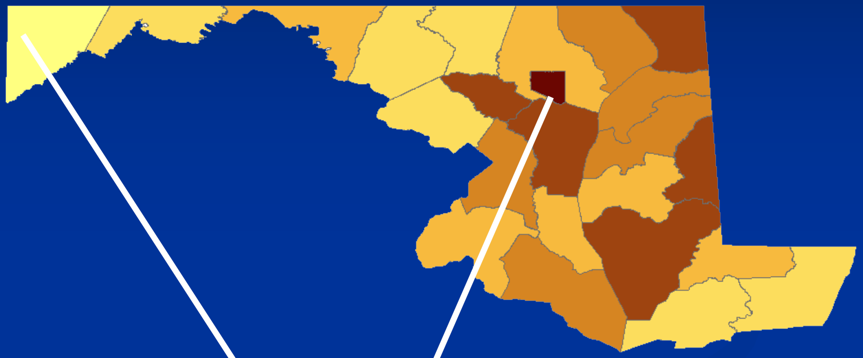
- Baseline data from met stations: 1960-1989
- Extreme Temperature Thresholds:
  - County and calendar day specific distribution of Tmax for 30 yrs with 31 day window center on each calendar day.
  - 95^{th} percentile of this distribution identified as Extreme Temp Threshold (ETT_{95})
  - ETT_{95} values specific to a calendar day and county

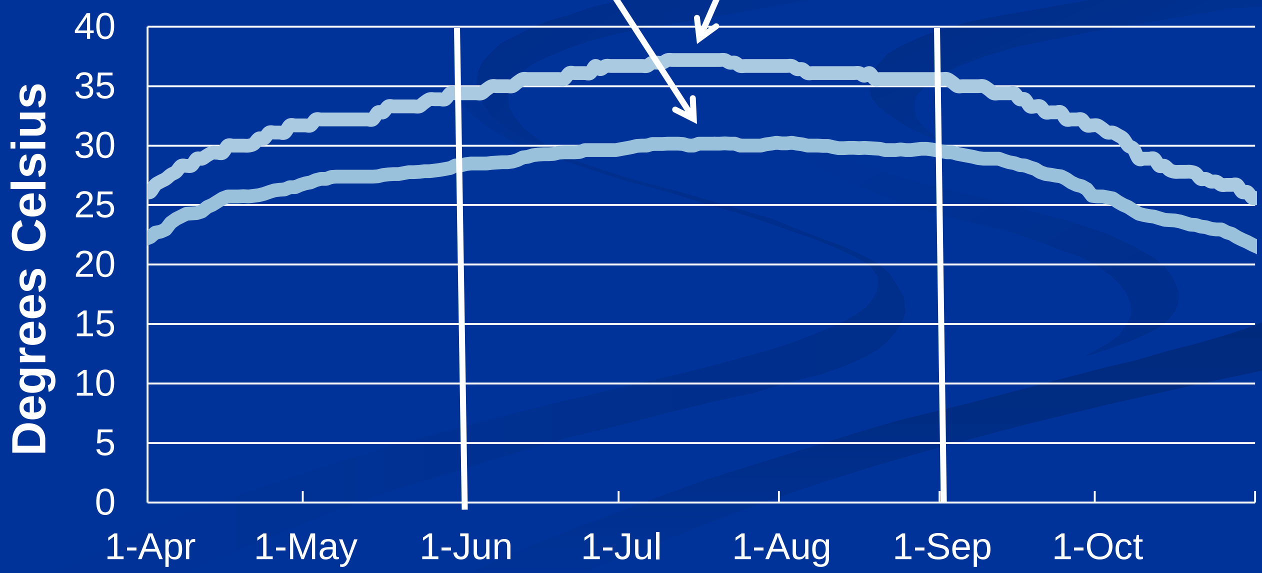
- Extreme Heat Events during 2002-2012: dichotomous variable
  - 1: if Tmax for a given calendar day > (ETT_{95})
  - 0: Otherwise

Extreme Heat Threshold

- Threshold used to define extreme heat varies by county and by day

Example: ETT95 values on July 15th
(Range: 30-36 C)





Study Population

- All Maryland hospitalizations
  - Principal discharge diagnosis of AMI (ICD-9 410)
  - Admission date in June - August from 2000 to 2012

- Additional variables
  - County of residence
  - Age
  - Gender
  - Race/ethnicity

- N= 32,670 hospitalizations

Statistical Analysis

- Time-stratified case-crossover study design
  - Case period: day of hospitalization (Lag0)
  - Control periods: 3 days (7, 14, 21 days before/after)
- Conditional logistic regression
- Lag periods: 1 day (Lag1) and 3 day cumulative (Lag0_2)
- Stratified models:
  - Age categories: 18-64 years and >=65 years
  - Gender (also by age cat)
  - Non-Hispanic White, Non-Hispanic Black (also by age cat)
- Sensitivity analyses
  - Controlling for $PM_{2.5}$ (2003-11)
  - Different threshold to define extreme events (ETT_{90})

Demographic Characteristics

Characteristic	# Cases	% of Cases
Age Category		
18-64	14,067	43.1
65+	18,603	56.9
Gender		
Female	13,948	42.7
Male	18,722	57.3
Race / Ethnicity		
Non-Hispanic Whites	22,343	68.4
Non-Hispanic Blacks	6,730	20.6
Hispanic	416	1.3
Other Races	1,413	4.3
Unreported	1,768	5.4

Odds ratios and 95% confidence intervals (CIs) for exposures to extreme heat (ETT95 exceedance) and AMI during summer months in Maryland, 2000-2012

Characteristic	Cases	Extreme Heat Event		
		Lag0	Lag1	Lag0_2
Overall Model	32,670	1.11 (1.05 – 1.17)	1.16 (1.09 – 1.22)	1.17 (1.12 – 1.22)
Gender				
Male	18,722	1.12 (1.05 – 1.21)	1.19 (1.11 – 1.28)	1.18 (1.12 – 1.24)
Female	13,948	1.09 (1.00 – 1.19)	1.10 (1.01 – 1.20)	1.16 (1.09 – 1.23)
Age				
Age 18-64	14,067	1.10 (1.02 – 1.20)	1.15 (1.06 – 1.25)	1.16 (1.09 – 1.23)
Age >=65	18,603	1.11 (1.04 – 1.20)	1.16 (1.08 – 1.25)	1.18 (1.12 – 1.24)
Race				
Non-Hispanic White	22,343	1.09 (1.02 – 1.16)	1.16 (1.09 – 1.24)	1.18 (1.12 – 1.23)
Non-Hispanic Black	6,730	1.27 (1.12 – 1.44)	1.15 (1.02 – 1.30)	1.21 (1.10 – 1.33)

Odds ratios and 95% confidence intervals (CIs) for exposures to extreme heat (ETT95 exceedance) and AMI during summer months in Maryland, 2000-2012

		Extreme Heat Event		
Characteristic	Cases	Lag0	Lag1	Lag0_2
Non-Hispanic White				
Age 18-64	8,697	1.01 (0.91 – 1.13)	1.13 (1.01 – 1.25)	1.13 (1.05 – 1.23)
Age 65+	13,646	1.14 (1.05 – 1.24)	1.18 (1.09 – 1.29)	1.20 (1.13 – 1.28)
Non-Hispanic Black				
Age 18-64	3,616	1.37 (1.16 – 1.62)	1.20 (1.02 – 1.42)	1.24 (1.10 – 1.41)
Age 65+	3,113	1.16 (0.96 – 1.40)	1.09 (0.90 – 1.32)	1.17 (1.02 – 1.35)
Male				
Age 18-64	9,734	1.14 (1.04 – 1.26)	1.17 (1.06 – 1.29)	1.18 (1.09 – 1.27)
Age 65+	8,988	1.10 (0.99 – 1.22)	1.23 (1.11 – 1.36)	1.18 (1.09 – 1.27)
Female				
Age 18-64	4,333	1.02 (0.87 – 1.19)	1.10 (0.95 – 1.28)	1.11 (0.99 – 1.25)
Age 65+	9,615	1.13 (1.02 – 1.24)	1.10 (1.00 – 1.22)	1.18 (1.09 – 1.27)

Strengths and Limitations

- Results generally consistent in sensitivity analyses
- High number of cases
- Extreme heat metric may account for local and time-specific temperature adaptability
- Hospitalization data
  - Unable to distinguish between recurrent hospitalizations
  - Information on onset limited to date of hospitalization
- Measures of relative humidity unavailable for this initial study

Conclusion

- Our findings suggest that exposure to extreme heat events increase the risk of AMI
- Additional studies are needed to understand the differential susceptibility across demographic subgroups